PAPERS AND ORIGINALS

Influence of Pregnancy Spacing on Outcome of Pregnancy

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Summary

To assess the significance of the length of time between two pregnancies on the outcome of the second we used information collected by the British Perinatal Mortality Survey of 1958. From questionnaires on the 16,994 singleton births in the first week of March 1958 and the 7,117 singleton stillbirths and neonatal deaths in March, April, and May 1958 we abstracted information on the date and outcome of any preceding pregnancy. The interpregnancy interval was taken as the length of time between this preceding pregnancy and the last menstrual period before the index pregnancy. The most important factors influencing pregnancy spacing were outcome of the preceding delivery, social class, and maternal age. When these variables had been taken into account we found that the length of interpregnancy interval had little effect on stillbirth rates. High neonatal death rates, however, occurred when interpregnancy intervals were less than six months ($P < 0{\cdot}005$), though longer intervals had no significant effects.

Introduction

Though the feeling among most obstetricians is that conception immediately after the birth of a child is to be avoided, and that too long a delay before conception may also give cause for anxiety, concrete evidence has so far been sketchy.

Early studies on small series (Hughes, 1923; Woodbury, 1925) showed a high infant mortality rate for short intervals between births. The defects in taking interbirth intervals were not pointed out until Eastman (1944) analysed details of 5,158 deliveries at the Johns Hopkins Hospital. Though he found a greatly increased incidence of stillbirth and neonatal death in the group of 71 deliveries occurring within 12 months of the preceding delivery he pointed out that not only did this group contain a larger proportion of Negroes and a dearth of private patients but also there was, inherent in the data, an excess of infants delivered prematurely—for example, the under-12-months group would include all deliveries to women who conceived within two months of their previous confinement but only the infants delivered prematurely to those who conceived after four to five months.

Yerushalmy (1945) used an indirect method to study this problem. He took the live and stillbirth records for the U.S.A. over a five-year period and compared the stillbirth rates for each birth order and maternal age group with that expected from the overall birth order and age rates. He found that the rates were greater than expected for the young mother with high birth order as well as for the older mother with low birth order. This he interpreted as evidence for both high birth concentration and pregnancies well spaced out being at high risk of stillbirth.

Studies were also carried out by Newcombe and Rhynas (1962) in Canada using record linkage techniques, and by Yerushalmy *et al.* (1956) on the island of Kauai, Hawaii, using reproductive histories reported by 6,039 women. In both series the number of deaths was small, and the measure for the first study was in terms of interbirth interval with all the defects pointed out by Eastman.

In our study we measured the actual length of time between the preceding delivery and the date of the last menstrual period before the index pregnancy.

Material and Methods

The British Perinatal Mortality Survey of 1958 was organized to collect two sets of data. Firstly, it attempted to study in detail all deliveries in the whole of England, Scotland, and Wales during the first week of March 1958 (the control week population). Secondly, a detailed examination was made of the stillbirths and neonatal deaths occurring in the same area over the three-month period March to May 1958 (the three-month deaths).

For both series of cases detailed information on the mother's social background, past obstetric history, history of present pregnancy, and delivery, as well as on the baby, was collected. It is estimated that 98·5% of actual births in the control week were covered in this way together with 95% of the deaths (Butler and Bonham, 1963; Butler and Alberman, 1969).

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For the purposes of the present study we went through the 24,000 questionnaires relating to singletons to abstract certain items of information that had not been coded when the data were first analysed. This included the month, year, and outcome of the preceding delivery. With the gestational period (in days) of the index cases already on punch cards the computer was used to calculate the length of time from the preceding delivery to the date of the last menstrual period before the index pregnancy. This was defined as the interpregnancy interval. The 10% of cases where the date of the last menstrual period was unknown or uncertain have been omitted.

When the preceding pregnancy had either been ectopic or resulted in the delivery of twins or of an infant surviving the neonatal period but dying subsequently it has been excluded from the present analyses, the numbers being too small for valid interpretation. We have, however, considered cases where a preceding miscarriage was reported. As the survey was conducted long before termination became legal in Britain it may be assumed that the vast majority of these cases were spontaneous abortions. The other two groups considered were cases in which the preceding delivery had resulted in (*a*) a stillbirth or neonatal death or (*b*) a livebirth where the child was still alive at the time of birth of the index case (a survivor).

Parity is defined as the number of previous pregnancies reaching a gestation of 28 weeks or more. Maternal age is the mother's age at the birth of the index case. Social class was based on the Registrar General's (1961) classification of the husband's occupation. Toxaemia was defined according to the criteria of Butler and Bonham (1963). Death rates are computed per 1,000 total births as

$$\frac{1{,}000 \times \text{Number of deaths in the three-month period}}{12 \times \text{Number of births in the control week}}$$

Results

The outcome of the preceding pregnancy was closely related to the interpregnancy interval. When the preceding pregnancy had ended in spontaneous abortion 37% of the mothers had conceived again within six months, compared with 28% of the cases where there had been a preceding death and 10% of cases where the preceding infant was still alive at the time of the survey. This effect was apparent regardless of parity (fig. 1).

It is now widely recognized that a woman who has had one perinatal loss is at increased risk of subsequently losing another infant in the perinatal period. It is also true that a woman who has had a spontaneous abortion is also at increased risk. Clearly, then, to include cases with preceding abortions, stillbirths, or neonatal deaths would be to bias the data. In the following analyses we therefore concentrated on those cases where the preceding delivery resulted in a survivor.

The distribution of interpregnancy interval with parity for the 8,356 deliveries where the preceding pregnancy had resulted in a survivor showed surprisingly little variation (table I), though

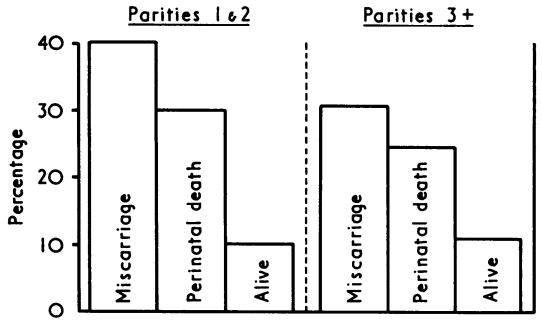

FIG. 1—Proportion of women conceiving within six months according to preceding outcome and parity (control week births).

TABLE I—*Distribution of Interpregnancy interval according to Parity when Preceding Infant had Survived (Control Week Births; Results expressed as Proportion of Deliveries*

Interpregnancy Interval (Months)	Parity							
	1		2		3		4 and over	
	No.	%	No.	%	No.	%	No.	%
≤6	424	10·1	208	10·0	79	7·9	150	13·8
–12	651	15·5	324	15·6	172	17·3	210	19·3
–18	633	15·1	257	12·4	123	12·4	152	14·0
–24	533	12·7	219	10·6	105	10·6	134	12·3
–36	758	18·1	270	13·0	145	14·6	160	14·7
–48	416	9·9	212	10·2	118	11·9	116	10·7
>48	786	18·7	584	28·2	252	25·3	165	15·2
Total	4,201	100·0	2,074	100·0	994	100·0	1,087	100·0

TABLE II—*Rate of Stillbirth and Neonatal Death according to Interpregnancy Interval (Preceding Pregnancy resulted in Survivor)*

Interpregnancy interval (Months)	≤6	–12	–24	–36	–72	–108	>108	Total
Death rate per thousand	30·9	25·1	26·6	26·9	30·5	41·2	48·0	29·5

there was a tendency for the women who already had two or three children to wait over four years before conceiving again. On the other hand, the grand multipara appeared to conceive again more rapidly than women of other parities.

The overall death rate is shown in table II. The crude figures suggest that the optimum time for conception is between six and 12 months after the previous birth, and the rate rises progressively from 36 months. Further analysis showed that this pattern appeared consistent within parity groups and regardless of preceding outcome.

A comparison of the rates of macerated stillbirth with those of the fresh stillbirths grouped together with the small number of neonatal deaths which occurred under half an hour showed that the same pattern applied in both—that is, an increase in incidence with lengthening interpregnancy interval. The neonatal deaths occurring after 30 minutes appeared to be responsible for the increased incidence of death among infants with a short interpregnancy interval (fig. 2)

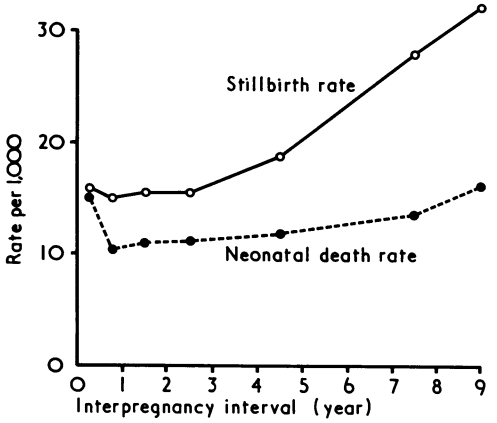

FIG. 2—Stillbirth and neonatal death rates according to interpregnancy interval.

BIRTH WEIGHT AND GESTATION

The proportion of infants with low birth weight was found to have a slightly U-shaped distribution (table III), being greatest with both long and short interpregnancy intervals. The proportion of infants delivered by the 35th week showed a similar distribution (table IV), with the greatest incidence in the under-six-months group. Surprisingly, perhaps, the incidence of

postmaturity was also highest in the group with short interpregnancy interval.

TABLE III—*Birth weight Distribution (Control Week; Preceding Pregnancy Resulted in Survivor). Results expressed as Proportion of Cases*

Interpregnancy Interval (Months)	Birth Weight (g)			Total Cases
	≤2,500	−4,000	>4,000	
≤6	6·7%	83·4%	9·9%	832
−72	4·9%	83·2%	11·9%	6,386
>72	6·5%	81·8%	11·7%	872
Total	5·2%	83·1%	11·7%	8,090

TABLE IV—*Gestation Distribution (Control Week; Preceding Pregnancy Resulted in Survivor). Results expressed as Proportion of Cases*

Interpregnancy Interval (Months)	Gestation (Weeks)				Total Cases
	≤35	−37	−41	>42	
≤6	4·5%	6·7%	74·6%	14·2%	861
−72	2·7%	6·2%	79·6%	11·5%	6,594
>72	3·4%	6·7%	80·8%	9·1%	901
Total	2·9%	6·3%	79·2%	11·6%	8,356

MOTHERS

The prevalence of anaemia in terms of the lowest recorded haemoglobin levels was examined. In 40% of the mothers the haemoglobin was not measured, but this proportion was roughly constant for each interval. There was a slight tendency for the group with a short conception delay to have a haemoglobin level of under 8·4 g/100 ml, but numbers were very small.

When the distribution of the toxaemias was examined it was seen that though there was a slight increase in the prevalence of severe toxaemia in the group of rapid conceivers the striking finding was an increase in all grades of toxaemia among the women with an interpregnancy interval of six years or more. Indeed only 60% of this group were normotensive and 7·1% had severe toxaemia, compared with 4·1% of the "rapid conceivers" and 3·8% overall.

The mothers were grouped according to whether they smoked one cigarette or more a day at any stage of pregnancy. There was little difference in the distribution of interpregnancy intervals between the two groups.

Marked variation in the distribution of interpregnancy intervals was, however, shown with social class (table V). Mothers in social classes IV and V appeared to be twice as likely to conceive within six months of the preceding delivery as those in social classes I and II. The small group of mothers with no husband also showed this pattern. On the other hand,

TABLE V—*Social Class by Interpregnancy Interval (Control Week; Preceding Pregnancy Resulted in Survivor). Results expressed as Proportion of Cases*

Interpregnancy Interval (Months)	Social Class									
	I and II		III		IV and V		No Husband		Other or Unknown	
	No.	%	No.	%	No.	%	No.	%	No.	%
≤6	91	6·6	472	9·8	255	13·5	13	15·7	30	14·9
−12	206	14·8	741	15·4	363	19·2	15	18·0	32	15·8
−18	235	16·9	627	13·1	266	14·1	13	15·7	24	11·9
−24	199	14·3	564	11·8	199	10·5	7	8·4	22	10·9
−30	161	11·6	425	8·9	143	7·6	6	7·2	15	7·4
−36	91	6·6	355	7·4	122	6·5	4	4·8	11	5·4
−48	134	9·7	538	11·2	158	8·4	10	12·1	21	10·4
−72	146	10·5	526	11·0	184	9·8	5	6·0	25	12·4
>72	125	9·0	547	11·4	197	10·4	10	12·1	22	10·9
Total	1,388	100·0	4,795	100·0	1,887	100·0	83	100·0	202	100·0

TABLE VI—*Maternal Age (Control Week; Preceding Pregnancy Resulted in Survivor)*

Interpregnancy Interval (Months)	Maternal Age (Years)									
	<20		20-24		25-29		30-34		>34	
	No.	%	No.	%	No.	%	No.	%	No.	%
≤6	47	43·1	344	20·7	257	9·2	132	5·9	62	4·3
−12	30	27·5	495	29·7	455	16·3	257	11·6	128	8·8
−18	16	14·7	299	18·0	481	17·2	239	10·8	130	8·9
−24	11	10·1	204	12·2	293	10·5	255	11·5	126	8·7
−36	5	4·6	202	12·1	597	21·4	371	16·7	158	10·8
−48	0	0	85	5·1	339	12·2	274	12·3	163	11·2
>48	0	0	37	2·2	369	13·2	692	31·2	689	47·3
Total	109	100·0	1,666	100·0	2,791	100·0	2,220	100·0	1,456	100·0

TABLE VII—*Observed Numbers of Deaths compared with that expected from Social Class and Maternal Age Distribution (Parities 1-3 only)*

Interpregnancy Interval (Months)	Stillbirths			Neonatal Deaths		
	Observed	Expected	O. − E.	Observed	Expected	O. − E.
≤6	115	96·8	+18·2	116	84·1*	+31·9
−12	158	169·9	−11·9	123	136·9	−13·9
−18	152	157·6	− 5·6	141	123·3	+17·7
−24	142	142·8	− 0·8	94	106·6	−12·6
−36	180	193·3	−13·3	132	146·4	−14·4
−48	121	133·7	−12·7	97	95·1	+ 1·9
−60	101	97·1	+ 3·9	51	65·3	−14·3
−72	70	64·3	+ 5·7	46	42·0	+ 4·0
−108	152	130·5	+21·5	76	76·4	− 0·4
>108	100	104·9	− 4·9	56	55·9	+ 0·1
Total	1,291	1,290·9		932	932·0	

*P<0·005.

the women with a long conception delay exhibited no trend with social class.

The most striking variation in the distribution of interpregnancy interval was, however, shown with maternal age (table VI). Whereas as many as 43% of the teenage mothers had a conception delay of under six months, only 4% of women over 34 did so; it should be noted that there were more women in the latter category though.

Thus maternal age and social class have the most profound effect on perinatal mortality and also vary within interpregnancy interval. In order to take account of both variables we calculated

$$E_i = \frac{12}{1{,}000} \sum_{a=1}^{6} \sum_{s=1}^{5} R_{as} \quad N_{asi}',$$

where E_i is the expected number of deaths for interpregnancy interval (i), R_{as} is the death rate for age group (a) and social class (s), and N_{asi} is the number of births in the control week with interpregnancy interval (i), maternal age (a), and social class (s). The computations were performed separately for stillbirths and neonatal deaths.

Though for stillbirths there was still an excess of observed deaths over the number expected when the interval was over six years (table VII) the difference was not significant, and even if the effect of prolonged interval was real it could be implicated directly only in some 7% (16·6/252) of stillbirths conceived at least six years after the previous delivery. On the other hand, the excess number of stillbirths found in the short-interval group, while still failing to reach significance, would be proportionately more important if a true effect, since it would be responsible for 16% (18·2/115) of the stillbirths in this category.

The picture is far easier to interpret for the neonatal deaths. There was no effect whatsoever with prolonged interpregnancy interval but a very significant excess of deaths occurred in the short-interval group ($P < 0.005$), accounting for 28% of the 116 deaths (table VII).

TABLE VIII—*Death Rate per Thousand Births by Primary Causes of Death (Preceding Pregnancy Resulted in Survivor)*

Cause of Death	Interpregnancy Interval ≤6 Months		All Intervals	
	Rate	No.	Rate	No.
Cerebral birth trauma	2·2	23	1·6	163
Birth asphyxia	4·7	49	5·7	567
Pneumonia	1·3	14	1·3	135
Hyaline membranes	1·8	19	1·1	113
Intraventricular haemorrhage	0·8	8	0·4	39
Massive pulmonary haemorrhage	0·7	7	0·3	31
Rhesus isoimmunization	1·0	10	1·2	117
Congenital malformation	3·8	39	4·1	408
Other causes	0·6	6	0·5	51
No major lesion	3·4	35	3·3	334
No necropsy	10·6	110	9·9	994

TABLE IX—*Death Rates per Thousand from Anencephalus, Spina Bifida, and Congenital Heart Disease (Preceding Pregnancy Resulted in Survivor)*

Interpregnancy Interval (Months)	Anencephalus	Spina Bifida	Congenital Heart Disease
≤6	1·45	0·68	1·84
–12	1·29	0·80	1·29
–18	2·15	1·07	1·00
–24	2·19	0·76	1·09
–48	1·63	0·87	1·37
>48	2·66	1·73	1·31
Total	1·91	1·04	1·31
No. of cases	192	104	131

CAUSE OF DEATH

We compared the incidence of various causes of death among the infants conceived within six months of delivery of their preceding sibling with the overall incidence (table VIII). The only causes of death in which there was a considerable increase in the former group were hyaline membrane disease, intraventricular haemorrhage, and massive pulmonary haemorrhage. Though there was no increase when all congenital malformations were taken together, when analysed separately there was an increase in the number of deaths due to congenital heart defect (table IX) when the interpregnancy interval was under six months. Statistical significance was not reached, however, there being 19 deaths with congenital heart disease in this group compared with an expected 13·5 ($P < 0.1$).

Discussion

We have shown that the length of the interpregnancy interval varies with several factors, but of special importance are maternal age, social class, and outcome of the preceding pregnancy. When considering only cases where the preceding child had survived and taking account of both maternal age and social class it became apparent that the interpregnancy interval was of little importance in the aetiology of stillbirths, though there was an increase in observed over expected numbers in the cases with both very short or long conception delays. Statistical significance was not reached.

On the other hand, there was a highly significant excess of neonatal deaths in the group conceived within six months of the preceding delivery and no effect thereafter. It appears that the excess of deaths in this group was due largely to causes linked with short gestation and growth retardation (Fedrick, 1969).

It seems likely that the finding we describe is but one end of a spectrum and that a follow-up of infants in the group with a short interpregnancy interval who survive the neonatal period may well indicate further ways in which these infants may be at special risk and might well confirm the study of Holley *et al.* (1969), who found delayed or impaired motor development and reduced mean I.Q. in a group of 250 infants conceived within three months of a previous term delivery.

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